THE OLD EROSION SURFACE IN IDAHO

A REPLY

JOSEPH B. UMPLEBY[1]

In a recent issue of this *Journal*[2] Mr. Eliot Blackwelder criticizes adversely the chain of reasoning that led me to the conclusion that the old erosion surface in Idaho is of Eocene age. To him the evidence seems to point to a much younger age, "probably post-middle-Miocene"—an inference which I believe to be incompatible with observed facts.

To account for the valleys now filled in many places with lavas, lake beds, and fluviatile deposits principally of Miocene age, Mr. Blackwelder suggests three possible explanations.

> One method is the deposition of the sediments in the bottoms of the valleys, in essentially their present state, as suggested in the [original] article. Again where weak materials have been down-folded or down-faulted between masses of harder rocks, they may be eroded to a lowland on account of differences of resistance to denuding processes. A third hypothesis is that the broad valleys occupied by the sediments were excavated and filled before the peneplain was made.

I shall endeavor to show that the first hypothesis only accords with field evidence. The second hypothesis is inadmissible because the old valleys constitute branching systems with members lying athwart the structure axes of the region. To derive all of these valleys by faulting would be to assume a complexity of fault systems in no wise borne out by field observations. Again, some of the lakes of Miocene age, as shown by fossil plants, present shore lines at elevations 2,800 feet beneath the plateau surface, so that even if down-faulting could be admitted the valleys in which the lakes existed must have been blocked out prior to the lacustrine epoch and hence prior to the Miocene. Therefore if the plateau

[1] Published with the permission of the Director of the United States Geological Survey.

[2] *Jour. Geol.*, XX, No. 5 (1912), 410–14.

surface is a product of planation it must antedate the existence of such Miocene lakes.

Still another line of evidence against the down-faulting or down-folding hypothesis is the direct observation from numerous exposures that folding or faulting is rare along the margins of the old valleys. In many places present-day streams have cut vertically from 1,000 to 3,000 feet or more into the lavas and tuffs which occupy the old valleys and thus afford excellent cross-sections of the earlier drainage channels. In the many sections of this kind which were examined, only one (near Junction, Lemhi County, and here the fault is post-Miocene) showed evidence of faulting and none presented down-folding. The eruptive rocks or lake beds, usually in a nearly horizontal position, abut the older formations irrespective of their attitude and in many places the lavas contain fragmental material, clearly picked up from the surface over which they flowed. Furthermore, the slope of the contact in every place observed is toward the lava area.

The third hypothesis, which supposes that the valleys antedate the old erosion surface, is controverted by the shore-line relations already referred to. If the valleys were developed *before* the elevation of the old surface of gentle topographic forms, we are led directly to the conclusion that within the area planated the upper 2,800 feet of some of the old valleys remained unfilled throughout the period of that planation. Would not those portions below base-level have been filled, and that, early in the period of reduction?

The third hypothesis is also untenable in view of the inequal depth of the lavas along certain of the old valleys. Take, for instance, the one which extends from near Salmon City, via Prairie Basin, Rabbitfoot, Custer, and Stanley Basin, to the Snake River plains at Camas Prairie. Prairie Basin, about 1,000 feet below the plateau level, Stanley Basin, about 2,500 feet below it, and Camas Prairie, yet lower, represent unfilled segments of this old valley, while intermediate sections are flooded with lavas which in places, as at Twin Peaks in Parker Mountain mining district and at Estes Mountain near Custer, rise a few hundred feet above the plateau level.

Furthermore, the third hypothesis is untenable because of the topography along certain of the present-day streams. Salmon River heads in the Stanley Basin segment of the old valley above mentioned but near Stanley leaves it and enters a canyon so narrow that there is scarcely room for a wagon road. This gorge continues to a point near Challis, a distance of about 50 miles, where the stream emerges into a broad, open depression. Fifteen miles below Challis the river enters another narrow canyon which it follows for about 30 miles to a point near Salmon City, and, after flowing for 20 miles through a third broad valley, again enters a gorge which it follows nearly to the western border of the state. These open stretches along the course of Salmon River cannot be explained by local structure or by differences of resistance to denuding processes. Their distribution and individual outline are readily interpreted, however, if we consider them to be parts of the older valley system. The general depression about Challis has its greatest elongation almost at right angles to the course of Salmon River, but is itself continuous with an old valley, now filled in many places with eruptive rocks, which drained off to the southeast and joined the Snake River plains near Martin. The open stretch about Salmon City presents numerous exposures of plant-bearing Miocene lake beds which extend off to the southeast along the present course of Lemhi River and Birch Creek. To an observer in the field it is very clear that these open stretches date back to the earlier topography and that, though in part filled with Miocene lavas and sediments, they have persisted as great depressions throughout their entire history.[1] Salmon River has crossed them by headward erosion.

In the preceding paragraphs I have endeavored to show (1) that the old valleys were not developed by down-folding or down-faulting and (2) that they were not excavated prior to the planation of the region. The remaining hypothesis holds that the valleys are the product of erosion and were developed after the elevation of the old

[1] During the past three field seasons many notes have been made on the old valleys of southeastern Idaho north of Snake River, and several hundred miles of their courses have been sketched. It is expected to assemble this information in a later paper.

erosion surface. This is the view which I advanced in my original paper and to which I still subscribe.

The inequal filling of the old valleys, their branching systems with members athwart the structure axes of the region, their cross-sections, the absence of particular folding or faulting along their margins, the shore-line relations of the lakes which occupied some of them in Miocene times, the open stretches along the present drainage lines—all these features stand opposed to the second and third hypotheses but at the same time strongly support the first one.

The constructive part of Mr. Blackwelder's criticism is based on the third hypothesis; namely, that the old valleys, now in part filled with Miocene deposits, were formed *before* the period of profound degradation which resulted in the old erosion surface of Idaho. The fact that in many of the valleys the filling material never accumulated to within many hundreds of feet (2,800 feet at Salmon City and Gilmore) of the present plateau surface, is not easy to explain on the basis of this assumption. Widely distributed, deep depressions could not have persisted within the area during the period of its reduction to gentle topographic forms.

Mr. Blackwelder also objects to my belief that the old valleys were formed during the Oligocene epoch. I am well aware of the uncertainties involved in "allowing a geologic period for a process of unknown time requirements," but it does seem that in this case time requirements are as well known as is the duration of the geologic period involved. The coincidence of the Oligocene epoch with the development of the old valleys is not considered as an essential part of the constructive argument in my former paper, but is rather a corroborative bit of evidence. A considerable time must have been consumed in the development of these great valleys, especially so since they lie far within the plateau area. If the drainage was westward, as is suggested in a later paragraph, the streams must have worked headward, at least across the state of Idaho. This follows from the fact that the plateau is continuous to near the western border of the state. Limits are placed on the period of valley development on the one hand by the Miocene deposits which occupy them, and on the other by the old erosion

surface, thought to be of Eocene age because of its relation to surrounding Eocene sediments. The closing stages of the Eocene may have been involved in the development of the old valleys, although I do not think so, but that erosion continued locally within them on into the Miocene and somewhat intermittently, even down to the present, is attested by abundant evidence. Such facts and possibilities, however, do not appear to me to affect the conclusion that the old valleys, here filled and there partially filled, are parts of a drainage system which should be considered as Oligocene.

The latter part of Mr. Blackwelder's paper is devoted to an effort to show that the old erosion surface "is much younger than Eocene and probably post-middle-Miocene." In the earlier part of this reply I have emphasized the fact that the deep erosion valleys were locally never filled by many hundreds of feet with Miocene or other lavas or sediments, and hence could not have been formed until after the old surface of gentle topographic forms had been developed, and not until after it was elevated at least well toward its present position. The hypothesis that the valleys were developed prior to the planation of the region necessitates that they persisted throughout the period of that planation and at its close remained as open trenches, some of them 2,800 feet deep, in an area which approached closely the base-level of erosion for the region.

Mr. Blackwelder's principal evidence for his contention that the old surface is of late Miocene age is the general folding which the Miocene deposits of the region have undergone—a folding which he argues would have destroyed the evenness of the plateau surface. The folding of the lacustrine deposits has been brought to my attention by numerous exposures in Lemhi and Custer counties. About Salmon City the lake beds, which, from their thin-bedding, must have been laid down in a relatively horizontal position, are now inclined in various directions, in most places at angles of about 10 degrees, but locally they dip as steeply as 25 degrees. It is noteworthy, however, that the dips, in every instance where I have observed them, change direction within short distances. The disturbance which folded these lake beds and locally faulted them, also folded and faulted the plateau surface, hence my statement

that "faulting and folding have affected the plateau area of central and eastern Idaho since its last elevation" but it has not destroyed its plateau character and "through all, the integrity of the old surface has persisted in a remarkable degree." From Salmon City to Gilmore, a distance of about 90 miles, the shore-line of the Miocene lake rises from 5,700 to 7,200 feet above sea, and along the same traverse the summits rise from 8,500 to 10,000 feet. Within this general rise to the southeast, however, are several subordinate anticlines and synclines.

A surface determined by the combined crestlines of the region would be "an undulating plain" dipping gently to the northwest and not a surface with maximum "declivities of but a small fraction of one degree" as Mr. Blackwelder seems to conceive it.

The casual reference which Mr. Blackwelder makes to the Payette formation as of late Eocene age, though not followed to its logical conclusion by him, touches upon what I believe to be the only essential weakness in my earlier paper. If the Payette formation is really of late Eocene age, either it must have been deposited in a different physiographic province or the old erosion surface must be crowded back, probably into the Cretaceous. I believe that the valley occupied by the Payette formation has a history coincident with the several valleys which I have studied—in fact that they are tributary to it. Near Hailey Mr. Lindgren found lacustrine deposits which, from their relations to the lavas and also from floral remains (*Sequoia angustifolia*), he believed to be Payette.[1] I have visited the Hailey locality and feel sure that the beds here mapped occupy a valley tributary to the one which earlier in this paper is described as extending from Camas Prairie nearly to Salmon City. I. C. Russel,[2] in his studies of the Snake River plains, was led to infer that the Payette formation extended eastward beneath the lavas—an inference supported by the relation of the plains to several of the old valleys which I have visited. From these observations it seems probable that the Payette formation, the lake beds at Salmon City, those at Challis, and the

[1] Waldemar Lindgren, *Twentieth Ann. Rept. U.S. Geol. Survey*, Pt. III (1898–99), p, 197.

[2] I. C. Russel, *Bull. U.S. Geol. Survey 199* (1902), p. 51.

several belts of lava in east-central Idaho all occupy valleys developed by streams of the same river system. Of these several beds, which from their topographic relations may reasonably be thought to be of about the same age, all have been referred to the Miocene except the Payette formation. In view of this fact it may be pertinent to review briefly our knowledge of the age of the Payette formation.

The Payette formation was first assigned to the Miocene,[1] but later because of a change in the reference of the deposits of Bridge Creek, Ore., which, in addition to a somewhat similar flora, have yielded vertebrate remains, it was shifted to the Eocene.[2]

The correlation of the Payette formation with the deposits of Bridge Creek is based on six species of plants which they have in common. The Payette flora, however, "embraces 32 forms, of which 17 were described as new and 5 were not specifically named, leaving, as then known [the first report] only 10 species having an outside distribution." Five of these were found at Bridge Creek "and to this list I am now able to add another species, thus making 6 of the 10 species common to these two localities."[3]

The other lake beds of the plateau region have not as yet yielded nearly as varied a flora as the Payette but it is hoped that additional search in the near future will add greatly to the collections from them. It is possible that during the next field season one of the paleobotanists of the United States Geological Survey will devote considerable time to this problem.

The only change which such studies may make in the age of the old erosion surface as now defined is to crowd it back toward or into the Cretaceous. This would result if the several localities yielded definite Eocene plant remains. The principal reason for my belief that such a change will not be made is expressed in my first paper as follows:

> It seems that the [surrounding Eocene] sediments could not have been derived from the region after its last elevation for two reasons: (1) It is very doubtful if the plateau is sufficiently dissected to afford the volume of material

[1] Waldemar Lindgren, *Twentieth Ann. Rept. U.S. Geol. Survey*, Pt. III (1900), 95.

[2] F. H. Knowlton, *Bull. U.S. Geol. Survey No. 204* (1902), p. 110.

[3] *Ibid.*, p. 110.

represented by the Eocene beds, and (2) all the more important valleys of the area drain westward, and in all probability have done so throughout their entire history. This is true of the Rocky Mountain trough, the Purcell trough, and the Snake, Salmon, and Columbia river channels. These, together with their tributaries, represent perhaps 90 per cent of the present dissection of the plateau region. If we assume that the old erosion surface is pre-Eocene the material derived from these several valleys may be thought to account for the narrow fringe of Eocene sediments on the west, but cannot account for the incomparably more extensive Eocene beds that lie to the east of the present plateau region.

In conclusion, I cannot agree with Mr. Blackwelder that "the evidence seems to show that this peneplain is much younger than Eocene and probably post-middle-Miocene." The evidence to me seems decisive that the plateau surface of the present day is much older than the late-Miocene. If it is other than Eocene, as concluded in my earlier paper, I believe that it must, because of evidence herein set forth, be crowded back toward or into the Cretaceous. Individual lines of evidence for assigning the old erosion surface of Idaho to the Eocene may not be conclusive but since all lines of approach, so far as I have been able to analyze them, point without discord[1] in the same direction, it seems to me that the assignment must be correct, and it is firmly believed that the surface does form a "valuable datum plane in broad areas where time relations between the Algonkian and the Pleistocene are otherwise obscured."

[1] Except the assignment of the Payette formation to the Eocene, as discussed above.